

### III.B.1 Correlations Between Calculations and Experiment

The data for 3 weight percent uranium trioxide and 93.2 weight percent uranyl nitrate in this section was obtained by the GAMTEC II (reference 1) and HFN (reference 2) codes. The GAMTEC II code was used to produce 18 neutron energy group cross-section sets that, in turn, were used in the HFN one-dimensional diffusion theory code to produce critical sizes, extrapolation distances and material bucklings. Unless otherwise indicated, the material bucklings for the other enrichments and the  $k_{\infty}$  and migration areas were obtained from the GAMTEC II code alone. GAMTEC II utilizes a special averaging technique to calculate two-group constants, one broad fast group and one thermal group. From these two group constants the code calculates the material buckling and  $k_{\infty}$ .

These parameters for low enriched uranium and the correlation of the GAMTEC II code to experimental data have been reported previously (reference 3).

The migration areas provided by the GAMTEC II code are high compared with those calculated using HFN material bucklings and GAMTEC  $k_{\infty}$ . When using the GAMTEC migration areas and material buckling, a  $k_{eff}$  within one percent of that calculated using HFN migration areas and material bucklings will result. Therefore, these GAMTEC 2-group parameters are included until the more accurate GAMTEC-HFN calculations for desired enrichments are justified.

The calculated effective multiplication constant of critical experiments obtained from GAMTEC II - DTF IV (reference 4) (18 groups) are also shown in this section. These results are included to show the calculational accuracy of the DTF IV code using multigroup constants of uranium provided by GAMTEC II.

In some cases, comparison is made with data from the criticality handbook issued by the United Kingdom Atomic Energy Authority(5) and is referenced as AHSB(U.K.) or U.K.

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- (1) L. L. Carter, C. R. Richey, C. E. Hughey, "GAMTEC II," BNWL-52, 1965.
  - (2) J. R. Lillie, "Computer Code HFN," HW-71545, 1961.
  - (3) K. R. Ridgway, "Calculated Critical Parameters of Low Enriched Uranium," ISO-174 and ISO-SA-4, 1966.
  - (4) K. D. Lathrop, "A Fortran IV Program for Solving the Multigroup Transport Equation with Anisotropic Scattering," LA-3376, 1965.
  - (5) J. H. Chalmers, et al, "Handbook of Criticality Data, Vol. 1," AHSB(S) Handbook 1, (1st Revision), 1967.

GAMTEC II - HFN and DTF IV calculations of critical experiments are listed below:

	K-Effective	
	<u>GAMTEC-HFN</u>	<u>GAMTEC-DTF</u>
<u>ORNL-TM-1195 <math>U(4.98)O_2F_2</math> 901 g U/l</u>		
15.39" I.D. Cylinder 40.04" high	0.989	0.996
<u>ORNL-2968 <math>U(4.89)_3O_8</math> In Sterotex 47.9 g U-235/1</u>		
Bare 24" x 24" x 18.8"	0.995	0.993
Full $H_2O$ Reflection 20" x 20" x 13.1"	0.988	0.987
<u>ORNL-1926 <math>U(93.2)O_2F_2</math></u>		
20" x 20" x 2.75" Full Reflection, 347.7 g U-235/1	0.9951	
6" I.D. Aluminum Cylinder 35.43" high, Full Reflection, 830.9 g U-235/1		1.0080
10" I.D. Aluminum Cylinder 5.17" high, Full Reflection, 830.9 g U-235/1		0.9773
10" I.D. Aluminum Cylinder 15.17" high, Bare, 830.9 g U-235/1		1.0028
<u>ORNL-3973 <math>U(4.98)O_2F_2</math> 910.18 g U/l, Bare</u>		
19.99 I.D. stainless steel (.020") sphere		1.0041
15.5" I.D. stainless steel (.031") bare		1.0042
<u>ORNL-2367 <math>U(93.2)O_2F_2</math> 331.4 g U-235/1, 10" O.D. Aluminum (4/16") Annular Tank, Full Reflection on Outside Except Top</u>		
4" I.D. filled with $H_2O$ 9.37" high		0.9973
4" I.D. with air 10.87" high		1.0491
4" I.D. 20 mil Cd sheet & air 12.56" high		1.0300
4" I.D. 20 mil Cd sheet & $H_2O$ 17.87" high		0.9754